SPECIFICATION

Replace paragraphs [0006], [0010], [0021], [0029], [0031], [0041] and [0044] with the corresponding amended paragraphs set forth below.

[0006] When measuring the gas transmission rates of deformable and/or brittle test materials, the exposure of the test material to vacuum conditions may result in false positives, or in other words transmission rates and nanoleaks (caused by flexing of materials) in excess of actual values. Brittle materials are those which manifest fractures upon being subjected to stress without appreciable prior plastic deformation. Deformable materials are those which exhibit alterations in shape, dimensions, thickness, etc., caused by stress and/or expansion or contraction of the material. Consequently for example, when a test material is elastomeric in nature the high-vacuum system of the mass spectrometer may stretch and expand the material to a point that results in an increase in the permeability of the material. As a result, gas transmission rates across the test material may be calculated as being higher than the actual transmission rate. Further, if the test material is brittle, as in the case of certain epoxies, direct exposure to high-vacuum conditions may cause the test material to fracture. One method of testing epoxies is to embed them in a metal holding plate. The plate contains machine-drilled holes and the epoxy test material is placed in the holes. The plate is then placed in a gas transmission test chamber similar to that depicted in ~~Figure~~ <u>FIG.</u> 1. The brittle epoxy may fracture and/or delaminate from the metal plate as a result of the high-vacuum conditions in the upper test chamber. This phenomena causes leakage of the test gas through the fractures and around the junctures where delamination occurs, which in turn results in transmission rates in excess of the actual gas transmission rate of the test epoxy material.

[0010] Further, when the gas transmission rate of the guard material is about ~~100~~ <u>one hundred</u> times greater than the transmission rate of the test material, TR_1 will drop out of the equation and the equation becomes:

$$\frac{1}{TR_3} = \frac{1}{TR_{TMS}}$$

[0021] FIG. 1 illustrates the test setup for conducting the first step of the method in accordance with the present invention. A test chamber 10 includes an upper diffusion cell 12 and a lower diffusion cell 14. A guard material 16 is positioned on top of the lower diffusion cell 14 and a support grid 15 is positioned on top of the guard material. The upper and lower diffusion cells 12 and 14 are then clamped together with support grid 15 and guard material 16 therebetween. It is desirable, but not essential, for the guard material 16 to have a certain rigidity so that it does not deform under the high-vacuum system of the mass spectrometer but the guard material should not be so rigid or brittle that it fractures. Polyester materials such as polyethylene terephthalate (e.g. ~~Mylar®~~ MYLAR® available from Dupont, Wilmington, Delaware); polystyrenes such as acrylonitrile butadiene styrene; and polycarbonate materials such as GE Plastics™ and ~~Lexan®~~ LEXAN® may be used. In the alternative, it is not essential that the guard material have any rigidity because the support grid 15, disclosed in further detail below, lends support to the guard material so that deformation does not occur. Therefore, any film forming material may be used as the guard material so long as it has a high gas transmission rate. For purposes of the present invention, guard materials having a transmission rate in the range of 0-500 cc/m^2-day are considered to be low transmission rate materials. High transmission rate materials are defined as those materials which permit the passage of molecules at transmission rates in excess of 500 cc/m^2-day. While any high transmission rate material may be used as the guard material in accordance with the present invention, ideally, the guard material preferably will have a gas transmission rate that is about ~~100~~ one hundred times greater than the gas transmission rate of the test material so that it is not a permeation barrier for the test gas. For example when measuring the gas transmission rate of helium, polyethylene terephthalate, available as ~~Mylar®~~ MYLAR® from Dupont, has both the requisite rigidity and a transmission rate of 1000 cc/m^2-day and provides an excellent guard material. Guard materials used in accordance with the present invention will preferably be approximately 5 mil in thickness but may vary depending on the size of the test chamber 10 and, the gas transmission rate of the test material.

[0029] Referring to ~~Fig.~~ FIG. 3 the test chamber used in the third step of the present invention is illustrated. In the third step the gas transmission rate of the combined guard material 16 and test material sample 34 are measured. Again, it will be appreciated that the guard

material 16 acts to support the test material sample 34 from deforming in the case of elastomeric materials and/or delaminating or fracturing in the case of brittle materials because the guard material 16 is exposed to the high-vacuum system 28 in the upper diffusion cell 12 and not the test material sample 34. In addition, it will be appreciated that the setup for the third test is identical as the second step except that the test gas 20 is once again used instead of the second gas 26. Porous support grid 15 is again used to protect the guard material 16 from delta pressures in the upper diffusion cell.

[0031] From these three measurements, the gas transmission rate of the test material sample may be calculated according to the following equation where

TR_1 = Transmission rate of Guard material
TR_2 = Transmission rate of Chamber Wall Seals
TR_3 = Transmission rate of Guard material and Test Material Sample

$$\frac{1}{(TR_3 - TR_2)} - \frac{1}{TR_1} = \frac{1}{TR_{TMS}}$$

Solving for TR_{TMS}

$$TR_{TMS} = \frac{(TR_3 - TR_2)\ (TR_1)}{(TR_1) - (TR_3 - TR_2)}$$

When the test is not present in air, TR_2 can be eliminated. The equation simplifies to:

$$\frac{1}{TR_3} - \frac{1}{TR_1} = \frac{1}{TR_{TMS}}$$

Solving for TR_{TMS}

$$\frac{(TR_3)\ (TR_1)}{TR_1 - TR_3} = TR_{TMS}$$

Further, when the gas transmission rate of the guard material is about ~~100~~ one hundred times higher than the gas transmission rate of the test material, TR_1 will drop out of the equation and the equation becomes:

$$\frac{1}{TR_3} = \frac{1}{TR_{TMS}}$$

[0041] Referring now to ~~Fig.~~ FIG. 5, the apparatus and process in accordance with the present invention is depicted for testing the gas transmission rates of sealed packages and the like. It is contemplated that the apparatus and process in accordance with the present invention may be used in a manufacturing setting to calculate the shelf life of certain products. For example, many types of athletic shoes such as ~~Nike®, Adidas®, and Saucony®~~ NIKE®, ADIDAS® and SAUCONY®, among others, include air bladders containing a gas in the lower support structure of the shoes to cushion the feet of runners, walkers, etc. who use them. As shoes are manufactured, a random sample of the air bladders may be obtained and allowed to equilibrate. After equilibrium is reached, the air bladder may be placed in the apparatus in accordance with the present invention, and the gas transmission rate of the bladder may be determined. Given the calculated gas transmission rate of the bladder, it can then be calculated what the expected shelf life of the air bladder and, therefore, the shoe will be. Depending on the value obtained, the sample bladder may or may not meet quality standards and the manufacturing process may be adjusted.

[0044] Referring to ~~Fig.~~ FIG. 5, in operation a sealed package, bladder, hard drive or any manufactured item 44 containing a test gas 20 is placed in the lower diffusion chamber 14 of the apparatus 10 in accordance with the present invention. It should be noted that the apparatus is identical to the apparatus of ~~Fig.~~ FIG. 1 with the exception that gas inlet valve 46 and gas outlet valve 48 are substituted for gas inlet 22 and gas outlet 24. Gas outlet valve 48 is in the on position and gas inlet valve 46 is in the open position while gas 26 is pumped into lower diffusion chamber 14. It is desirable to flush the test chamber with three to five times the volume of the test chamber. After flushing diffusion cell 14 for several minutes, both valves are closed. The test gas 20 contained within package 44 diffuses from the high gas concentration side of the

test chamber across the package membrane, the guard material and the support grid, which is completely porous and does not hinder diffusion to the low gas concentration side. It is important to note that both gas 20 and gas 26 diffuse across the guard material and support grid, however, because the mass spectrometer is tuned to the test gas 20, gas 26 is not measured. The gas transmission rate of the sealed package is then calculated using the formula above. If a guard material is being used that has a gas transmission rate of less than about ~~100~~ one hundred times the gas transmission rate of the sealed package material (the test material), those skilled in the art will appreciate that the test to measure the gas transmission rate for the guard material, as described above, should be included in operation and in the calculation.